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July  
1999*Ministry of the Environment programs and initiatives*

## Cleaning up the Deloro Mine Site

For 100 years private mining and refining operations at the Deloro Mine Site contributed to the prosperity of Ontario. But that prosperity came with a price — serious and extensive environmental degradation. The last owners abandoned the site in 1979, leaving behind a complex blend of contamination. The Ministry of the Environment made every effort to force the company to clean up the site, but when efforts failed, the ministry stepped in to address the problem. During the last 20 years, the ministry has made significant reductions in the contamination. Since 1983, the arsenic treatment plant has reduced the annual arsenic loading to the Moira River by more than 80 per cent. The ministry's final remediation plan is designed to control and securely contain all types of contamination at the site — from arsenic to radioactivity. The plan will take two to three years to complete at an estimated cost of \$18 million.

*The Ministry of the Environment's final remediation plan for the Deloro Mine Site is a plan designed to securely contain all types of contamination at the site — from arsenic to radioactivity. The plan will take from two to three years to complete at an estimated cost of \$18 million.*

### A century of contamination

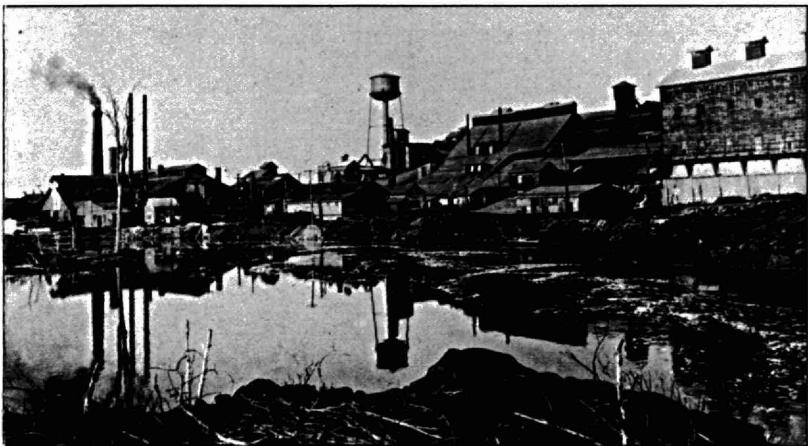
Situated where the Canadian Shield intersects the Great Lakes lowlands, some 200 kilometres southwest of Ottawa and 65 kilometres east of Peterborough, the Deloro area is rich in mineral deposits. In 1866, gold was discovered — the name Deloro is based on the Spanish word for gold — and within five years, numerous shafts had been sunk and refining facilities had been constructed. The extraction of gold was no easy

task. The gold-bearing ore was bound up with arsenic, a potentially dangerous byproduct.

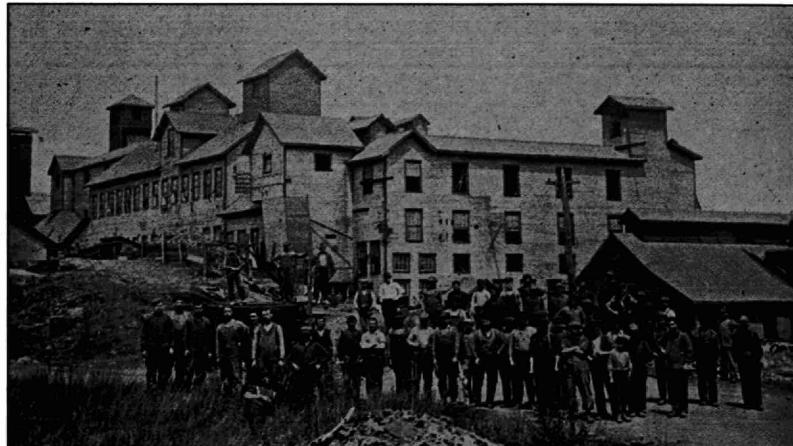
The gold mines closed in the early 1900s and the site was used to process silver and cobalt ores from mines in northern Ontario. In the 1930s, 1940s and 1950s, smelted ore was brought from Eldorado Nuclear Limited in Port Hope for further refinement to extract the cobalt. Deloro was the first plant in the world to produce cobalt commercially and was also a leading producer of stellite, a cobalt-chromium-tungsten alloy highly valued during the war years. Ores from all over the world were processed in Deloro's smelter.

Pesticides were produced from the arsenic byproducts of the smelting operations and continued as a major activity at the site until those products were replaced by organic pesticides in the late 1950s.

By the time the mining and refining operations were shut down, nearly a century's worth of hazardous byproducts and residues — a complex blend of toxic compounds, heavy metals and low level radioactive wastes — remained on the property. Early cleanup efforts also uncovered serious contamination of the site's soil, surface waters and groundwater.



Deloro Mine Site early 1900s.



Staff photo at the Silver plant — Deloro, circa 1920s.

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## The ministry gets involved

The Ministry of the Environment, formed in 1973, turned its attention to the Deloro Mine Site in the late 1970s. In 1978, the ministry issued an order under the *Environmental Protection Act* to force the property's owner, Erickson Construction Company Limited, to take steps to control the discharge of arsenic to the nearby Moira River. The company was operating a treatment plant that cut the acidity of wastewaters discharged off-site, but there was little action being taken to reduce the amount of arsenic going into the river. Erickson Construction failed to comply with the terms of the ministry order and, in 1979, declared a lack of operating funds. An order was then issued against the company to cease operations that affected the environment. The company abandoned the site and the ministry took control of the property and the existing wastewater treatment plant.

## Addressing immediate concerns

When the ministry took control of the site, the most pressing concern was the arsenic leaching into the Moira River and the potential threat it posed to the environment and to communities downstream. The goal was to eliminate the immediate source of contamination and to reduce runoff into the Moira River. The ministry focused its initial efforts on upgrading the existing wastewater plant. Plans were developed for the creation of a new arsenic treatment plant and, by 1983, the collection, storage and treatment facility was in operation. Additional pumping stations were installed in 1984 and 1985 to collect groundwater from other contaminated areas. Containment and leachate collection facilities established by the ministry are now operated by the Ontario Clean Water Agency.

The ministry also tackled other major sources of arsenic on the site. A number of contaminated industrial buildings, used for collecting and processing arsenic from the smelting days, were demolished. The areas where these structures stood were regraded and seeded. Eight hectares of red mud tailings, the arsenic contaminated byproduct from the smelting process, were covered to a depth of 0.5 metres with approximately 76,000 tonnes of crushed limestone in order to eliminate wind and surface water erosion, elevate the pH of the tailings and stabilize the containment dams.

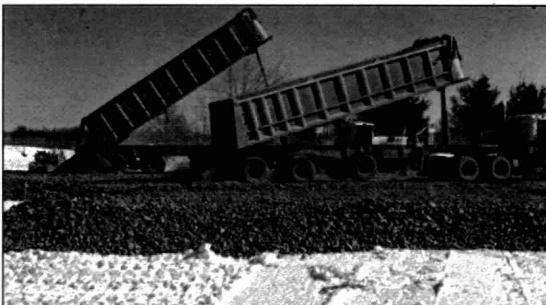
Ongoing monitoring shows that arsenic concentrations in the Moira River have been substantially reduced since the ministry took control of the site. In 1979, the annual average of arsenic escaping into the river was 52.1 kilograms a day.



*Ferric arsenate sludge: the byproduct of the arsenic treatment plant.*



*The Deloro Mine Site about 1983, before the red mud tailings were covered.*



*Covering the red mud tailings with crushed limestone.*

Since the arsenic treatment plant was put in operation in 1983, the arsenic going into the river has been reduced by more than 80 per cent, to an average amount of less than 10 kilograms a day.

An extensive sampling network is in place to monitor surface and groundwater quality at the Deloro site. A series of collection stations on the Moira River and Young's Creek provide information on surface water, while monitoring wells on the property are used to assess groundwater contamination. Depending on the location of the sampling station, samples are taken hourly, daily, weekly, monthly or quarterly. Water is also carefully monitored as it enters and leaves the treatment plant. This level of testing and monitoring is expected to continue into the foreseeable future.

## Rehabilitation strategy – creating the blueprint

The project at Deloro was a work in progress — while there was success at the arsenic treatment plant there was more work to be done at the site. In 1992 a multi-phased rehabilitation strategy was developed. It would provide the blueprint for the work needed to achieve final site remediation.

The strategy identified two problems that had to be addressed right away. First, the existing ferric arsenate sludge, a hazardous waste from the arsenic treatment plant, had to be dealt with. On-site storage was not an option because there were no secure hazardous waste containment systems in place. The material was moved to secure hazardous waste landfills in Quebec and Ontario.

The other major concern was worker safety. Abandoned mine shafts and other mine hazards were scattered over the site's 242 hectares, with little information on their number or precise location. Further environmental cleanup work over much of the property could not proceed until the mine workings were located and sealed.

In 1992, in consultation with the Ministry of Northern Development and Mines, the ministry undertook an in-depth review of local mining claims and historical data to locate and identify the collapsing mine shafts. Land surveys were conducted and ground-penetrating radar was used to pinpoint underground workings. By 1995, all mine shafts had been located, secured, and either fitted with reinforced concrete shaft caps, or backfilled according to the specifications of the Ministry of Northern Development and Mines. The project took three years to complete with funding assistance from Environment Canada and the Ministry of Northern Development and Mines.

## Developing the long-range remediation plan

With the site safe for workers, the ministry could proceed with the necessary field work to determine the best options for the final cleanup, containment and management of on-site contaminants. An engineering consulting firm was hired in 1997 and in-depth field investigations began in June of that year. Problems that had been identified earlier were now studied in greater detail. This phase of the work was completed in June 1998.

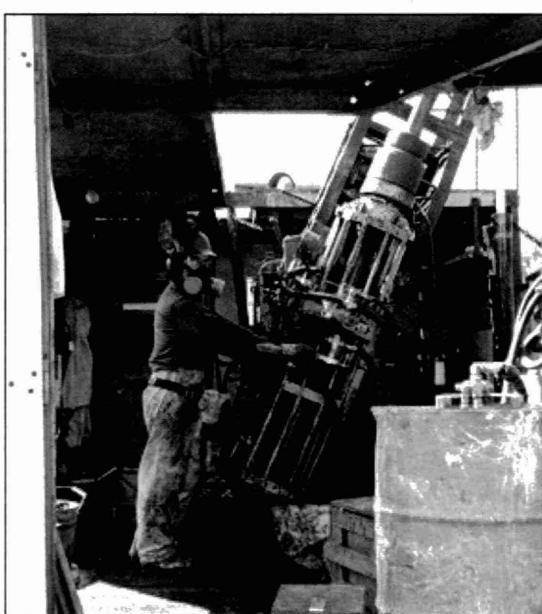
The final remediation work will deal with all contaminants at the site — from arsenic to radioactivity. Upgrades will be made to the arsenic treatment plant and work will proceed to stabilize and secure the red mud tailings area. On the west side of the river, the infrastructure associ-



*Surveying the mine site.*



*Seven major mine shafts were fitted with reinforced concrete shaft caps according to the Ministry of Northern Development and Mine's standard shaft cap design.*



*A diamond bit drill took core samples that were used to assess the stability of the crown pillars (i.e. ground above the old mining stopes).*

ated with the smelting and refining plant will be demolished. On-site hazardous waste disposal facilities will be established to securely contain contaminated materials currently on the property. The process will take approximately two to three years to complete at an estimated cost of \$18 million. Site preparation work is targeted to begin in the fall of 1999 and major construction/rehabilitation work in the year 2000.

## Dealing with off-site concerns

The ministry is committed to defining the extent of any off-site environmental problems associated with the Deloro Mine Site, including the potential for contamination in the former village of Deloro and in the Moira River watershed. Soil samples taken beyond the boundaries of the mine site showed the presence of arsenic, cobalt, nickel, silver and other heavy metals. Airborne pollutants released during nearly 100 years of mining and refining are the most likely cause of this contamination.

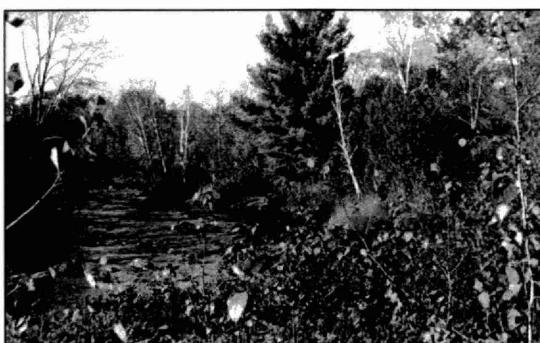
These preliminary findings were reviewed with the local medical officer of health and, after consultation, the ministry concluded there was a need for further investigation. In 1998, the ministry, in co-operation with the Hastings and Prince Edward Counties health unit and the Ministry of Health, launched an environmental health risk study in the former village of Deloro. The study examined total exposure to contaminants through air, soil, drinking water and food to determine if elevated levels of contaminants were present. It also examined the potential for health risks in the community. The final report, released in 1999, provides the findings of the study.

In December 1998, the ministry also launched a detailed study of the Moira River system to define the extent of problems originating from the Deloro Mine Site and to address public concerns. The study will assess the extent and significance of contamination and predict the environmental response to remedial work at the Deloro Mine Site. The final report is scheduled for completion in the spring of 2000.

In all aspects of the cleanup work, the ministry is maintaining close contact and consultation with those groups, agencies and citizens who are potentially affected by their proximity to the Deloro Mine Site. The ministry meets regularly with three project liaison committees to keep them informed and to gather their input and comments on cleanup reports and projects.



*Deloro Mine Site, summer 1997.*



*The Moira River.*

The ministry's efforts to this point have significantly decreased arsenic concentrations and loadings to the Moira River, but more work is needed. The ministry's final remediation plan is designed to result in the control and secure containment of all types of contamination at the site — from arsenic to radioactivity.

## For more information, please contact:

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## Chronology – Deloro Mine Site Ministry of the Environment activities and spending

### Early involvement

1973

- Ministry of the Environment created.

1978

- Ministry issues order, under the *Environmental Protection Act*, to site owner Erickson Construction Company Limited to control arsenic discharges to Moira River.

1979

- Company fails to comply with order and declares lack of sufficient funds for cleanup.
- Ministry issues order against the company to cease operations that affect the environment.
- Ministry takes control of site and water treatment facility, when Erickson Construction Company Limited abandons the site.

### Ministry control – addressing immediate concerns Spending: \$5.4 million



Interior of the arsenic treatment plant.

#### Wastewater treatment

1979-86

- Immediate concern — arsenic seeping to the Moira River.
- Ministry upgrades existing wastewater treatment plant. Engineering and construction plans created for new arsenic treatment plant.

- New collection, storage and treatment system built and operational by January 1983.
- Renovations made to aging research building. Installation of dike to divert highly contaminated groundwater in the vicinity of the former arsenic baghouse. Installation of equalization pond to provide storage for contaminated groundwater and to optimize treatment plant operations. Installation of pumping stations to pump contaminated groundwater to the equalization pond. Installation of collection tile system.
- Three more pumping stations added to collect groundwater from contaminated areas for treatment.
- Sludge-storage lagoon added to contain sludge produced at arsenic treatment plant.

### Eliminating contaminated buildings

1984-86

- Demolition of contaminated industrial buildings — arsenic baghouse (used to collect arsenic as a flue dust from smelting operations) and pesticides building (used in the manufacture of arsenical based pesticides, herbicides and rodenticides) — to remove significant sources of arsenic contamination.
- Area covered, regraded and seeded to reduce dust and improve surface water runoff.

### Dealing with red mud tailings

1986-87

- Eight hectares of red mud tailings (arsenic contaminated byproduct from the smelting processes) covered to a depth of 0.5 metres with approximately 76,000 tonnes of crushed limestone. Purpose — to eliminate wind and surface water erosion, stabilize containment dams and elevate the pH of the tailings to reduce leaching of arsenic and heavy metals.

1987

- Ownership of the Deloro Mine Site defaults to the Crown.

### Waste removal

1989

- Removal and safe disposal of arsenical based pesticides and arsenic waste stored in old power house building.
- Removal of bulk quantities of waste oils from three on-site tanks.

### Rehabilitation strategy – creating the blueprint Spending: \$6.5 million

1989-91

- Investigation and engineering work — site hazards.
- Investigation and engineering work for removal and cleanup of abandoned smelting facility.

1992

- Finalization of a multi-phased, multi-year rehabilitation strategy — the blueprint outlining steps necessary to achieve final remediation of the site.
- First two priorities: establish safe working conditions by eliminating mine hazards; remove existing inventory of treatment plant sludge.

## Establishing safe working conditions

### Mine hazards

1992-93

- Engineering plan to address mine hazards developed in consultation with Ministry of Northern Development and Mines (MNDM).
- In-depth investigation of mine hazards.
- Research, review, and collection of historical data to locate, identify and secure collapsing mine workings.
- Site surveys to pinpoint location of all mine workings.
- Engineering work to design closure measures.

1993-1995

- Backfilling of mine shafts according to MNDM specifications.
- Construction work in mine area – elimination of unsafe ground, blasting of unstable crown pillars.
- Engineered rock plugs and concrete shaft caps used to seal major mine openings.
- Regrading for surface water runoff control.

### Sludge removal

1992-94

- Sludge byproduct from arsenic treatment plant (hazardous waste) removed from the site to off-site hazardous waste landfills.

### Unsafe buildings

1996

- Demolition of three structurally unsafe site buildings.

## Proceeding with final remediation

### Stage 1 field work

1996-97

- Approval of first stage of implementation of rehabilitation strategy.
- Hiring of prime consultant for provision of project management and consulting engineering services.
- Stage 1 of rehabilitation strategy – field work-in-depth investigation of the Industrial Area, Tailings Area, Mine Area, and Young's Creek to answer outstanding questions and identify options for cleanup of all contaminants at the site.

1998

- Additional field work and feasibility studies to define Stage 2 construction activities.

1999

- Completion of Stage 1 field studies and reports.
- Selection of best alternative for remediation of the four areas of the site. (in progress)
- Public consultation on final remediation plan. (planned)

### Stage 2 construction

1999

- Stage 2 of rehabilitation strategy- implementation of the final remediation plan.
- Construction/and cleanup work targeted to begin, with completion in two to three years.

**Total spending to date: \$11.9 million**

**Estimated future spending: \$18 million**

## Beyond the boundaries — addressing off-site issues

### Environmental health risk study

1998

- Ministry initiates comprehensive environmental health risk study in community of Deloro, in co-operation with medical officer of health, Ministry of Health, Ministry of Labour and community representatives.
- Study to help define boundaries of contamination from former mining and refining operations and potential health effect from any off-site contamination.
- Final report and recommendations released summer 1999.

### Moira River study

1998

- Ministry commits to undertake detailed study of Moira River system to define extent of problems associated with the former Deloro Mine Site and address public concerns.
- Study to assess extent and significance of contamination, and predict environmental response to the remedial work at Deloro Mine Site.

1999

- Work begins in January. Target for completion – December 1999.
- Final report and recommendations planned for release spring 2000.